531 Rec'd PCT/PTO 13 DEC 2001

FORM-PTO-1390 (Rev. 9-2001) | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 032326-183

U.S. APPLICATION NO (If known, see 37 C.F.R. 1.5): Unassigned 10/009801

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR00/01494	30 May 2000	15 June 1999

TITLE OF INVENTION: DEVICE AND METHOD FOR MAKING DEVICES COMPRISING AT LEAST A CHIP MOUNTED ON A SUPPORT

APPLICANT(S) FOR DO/EO/US: Bernard CALVAS, Jean-Christophe FIDALGO and Philippe PATRICE

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☐ Other items or information:

21839

531 Rec'd PCT/PT 13 DEC 2001

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
Unassigned 10/009801	PCT/FR00/01494	032326-183

21. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1,040.00 (960)		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $890.00 (970)		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $740.00 (958)		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) $710.00 (956)		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00 (962)		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00	
Surcharge of **$130.00 (154)** for furnishing the oath or declaration later than 20 ☐ 30 ☐ months from the earliest claimed priority date (37 CFR 1.492(e)).	$ -0-	

Claims	Number Filed	Number Extra	Rate		
Total Claims	18 -20 =	-0-	X$18.00 (966)	$ -0-	
Independent Claims	2 -3 =	-0-	X$84.00 (964)	$ -0-	
Multiple dependent claim(s) (if applicable)			+$280.00 (968)	$ -0-	
TOTAL OF ABOVE CALCULATIONS =				$ 890.00	
Reduction for 1/2 for filing by small entity, if applicable (see below).			+	$ -0-	-
SUBTOTAL =				$ 890.00	
Processing fee of **$130.00 (156)** for furnishing the English translation later than 20 ☐ 30 ☐ months from the earliest claimed priority date (37 CFR 1.492(f)).			+	$ -0-	
TOTAL NATIONAL FEE =				$ -0-	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00 (581)** per property			+	$ 40.00	
TOTAL FEES ENCLOSED =				$ 930.00	
				Amount to be refunded:	$
				charged:	$

a. ☐ Small entity status is hereby claimed.

b. ☒ A check in the amount of $ 930.00 to cover the above fees is enclosed.

c. ☐ Please charge my Deposit Account No. 02-4800 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

d. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4800. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

James A. LaBarre
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

SIGNATURE

James A. LaBarre
NAME

28,632
REGISTRATION NUMBER

December 13, 2001
DATE

Patent
Attorney's Docket No. 032326-183

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Bernard CALVAS et al Application No.: Unassigned Filed: December 13, 2001 For: DEVICE AND METHOD FOR MAKING DEVICES COMPRISING AT LEAST A CHIP MOUNTED ON A SUPPORT	Group Art Unit: Unassigned Examiner: Unassigned

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination and the calculation of filing fees, kindly amend the above-identified application as follows:

IN THE SPECIFICATION:

Page 1, immediately following the title appearing on lines 1 and 2, insert the following:

--This disclosure is based upon French Application No. 99/07549, filed on June 15, 1999 and International Application No. PCT/FR00/01494, filed May 30, 2000, which was published on December 21, 2000 in a language other than English, the contents of which are incorporated herein by reference.

Background of the Invention--

Page 3, before line 7, insert the following heading:

--**Summary of the Invention**--

Page 8, before line 1, insert the following heading:

--**Brief Description of the Drawings**--

Page 9, before line 8, insert the following heading:

--**Description of the Invention**--

Add the following Abstract:

--A method for making a device, such as a smart card, of the type having a support associated with at least a microcircuit in the form of a chip. First, an assembly is provided that constitutes a thin chip maintained by a first surface integral with a substrate, and having on an opposite second surface at least a bond pad. On a surface of the support, a communication interface is formed that includes at least a connecting element with the chip. The assembly having the chip and the substrate is placed against the communication interface, with at least a bond pad of the chip positioned against a corresponding connection element of the communication interface. Each pad is integrated with its respective connection element. The substrate is then removed from the first surface of the chip. The method advantageously uses SOI chip technology.--

IN THE CLAIMS:

Kindly replace claims 1-14, as follows.

1. (Amended) A method for manufacturing a device with an integrated circuit chip with at least one active surface provided with at least one connection pad and an opposite face, said method comprising the steps of:

initially providing a thin active circuit which has mechanical flexibility;

affixing the thin active circuit to a stiffening substrate via its opposite face to form an assembly composed of the thin active circuit and the stiffening substrate;

forming in the general plane of a face of a final support a communication interface having at least one element for connection with the active circuit;

presenting this assembly, comprising the active circuit with its stiffening substrate, against the communication interface, with the connection pad against a corresponding connection element;

fixing and electrically coupling the connection pad with a corresponding connection element; and

removing the stiffening substrate from the opposite face.

2. (Amended) A method according to Claim 1, wherein the communication interface comprises at least one of an ohmic contact area and antenna area protruding on a portion of a surface in the general plane of the face of the final support.

3. (Amended) A method according to Claim 1 wherein the connection pad is fixed and coupled with its respective connection element by welding by means of a laser beam which passes through the stiffening substrate and the active circuit, said substrate and circuit being transparent to the wavelength used for the welding, whilst the pad and/or the connection element is fusible under the effect of said laser beam.

4. (Amended) A method according to claim 1 wherein the support for fixing the active circuit is in roll form.

5. (Amended) A method according to claim 1 further including, after the step of removing the stiffening substrate, a step of depositing, on the opposite face, a protective film by lacquer printing.

6. (Amended) A method according to claim 1 further including a step of cutting the assembly including the active circuit and the stiffening substrate into an assembly cut substantially to the dimensions of the circuit, before the step of presenting this assembly.

7. (Amended) A method according to claim 1 wherein each pad is fixed with its respective connection element by a compression force that is applied through the stiffening substrate of the assembly.

8. (Amended) A method according to Claim 6, wherein the connection pad is fixed and coupled with its respective connection element by welding by means of a laser beam which passes through the stiffening substrate and the active circuit, said substrate and circuit being transparent to the wavelengths used for the welding, whilst the pad and/or the connection element is fusible under the effect of said laser beam.

9. (Amended) Tooling for implementing the method according to Claim 8, comprising a laser with a wavelength of 1.06 μm, whose beam is transmitted by a plurality of optical paths, each directed towards a respective pad of the active circuit, in order to effect welds in parallel.

10. (Amended) Tooling according to Claim 9, wherein each optical path is produced by at least one optical fibre.

11. (Amended) Tooling according to Claim 9 wherein the optical paths are integrated in a tool for positioning and/or holding the assembly vis-à-vis the final support.

12. (Amended) A device with an integrated-circuit chip comprising at least one active circuit with a front face provided with at least one connection pad and an opposite face, said active circuit being a thin active circuit which has mechanical flexibility, and which is mounted on said support;

an interface in the overall plane of one face of the support for communication with at least one element for connection with the active circuit and;

said connection pad being fixed and electrically coupled against a corresponding connection element on said interface.

13. (Amended) A device according to Claim 12, further including a protective film over the surface of the support.

14. (Amended) A device according to Claim 12 wherein the thickness of the connection elements and of the active circuit with its pads is less than 50 microns.

Add the following new claims:

15. (New) The method of claim 3, wherein said laser beam has a wavelength of about 1.06μm.

16. (New) The method of claim 5, wherein said communication interface comprises an ohmic contact area, and further including the step of removing the film from said area.

17. (New) The method of claim 5, wherein said film has a thickness in the range of 5-15 μm.

18. (New) The device of claim 13, wherein said film has a thickness in the range of 5-15 μm.

REMARKS

Entry of the foregoing amendment is respectfully requested. This amendment is intended to place the claims in a more conventional format and eliminate the multiple dependency of the claims.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: ______________________
James A. LaBarre
Registration No. 28,632

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

Date: December 13, 2001

Attachment to Preliminary Amendment dated December 13, 2001

Marked-up Claims 1-14

1. (Amended) A method for manufacturing a device with an integrated circuit chip [such as a smart card or an electronic label; this device having a support (2) associated] with at least one active surface [such as a chip (6) with a front face (6a)] provided with at least one connection pad [(12)] and an opposite face [(6b); this], said method comprising the steps [consisting] of:

initially providing [for the active circuit] a thin active circuit [(6)] which has mechanical flexibility[, such as a chip (6) or flat-screen display; keeping];

affixing the thin active [surface (6) fixed] circuit to a stiffening substrate [(8) through] via its opposite face [(6b) referred to as the first face; removing the active circuit (6) from its stiffening substrate (8); mounting the active circuit (6) on a final support (2); characterised by the steps consisting in:

- presenting the active circuit in] to form an assembly composed of [this] the thin active circuit [(6)] and the stiffening substrate [(8)];

[-] forming in the general plane of a face [(2a)] of [the] a final support [(2)] a communication interface [(4)] having at least one element [(4b)] for connection with the active circuit [(6), on the final support (2); then];

[-] presenting this assembly, comprising the active circuit [(6)] with its stiffening substrate [(8)], against the communication interface [(4)], with the connection pad [(12)] against a corresponding connection element [(4b; 24a, 24b)];

Attachment to Preliminary Amendment dated December 13, 2001

Marked-up Claims 1-14

[-] fixing and electrically coupling the connection pad [(12)] with [its] a corresponding connection element [(4b; 24a, 24b), for example by laser welding; then]; and

[-] removing the stiffening substrate [(8)] from the opposite face [(6b)].

2. (Amended) A method according to Claim 1, [characterised in that] wherein the communication interface [(4) is formed or produced in the form] comprises at least one of an ohmic contact area [(4a) and/or] and antenna area [(24),] protruding on a portion of a surface in the [overall] general plane of the face [(2a)] of the final support [(2)].

3. (Amended) A method according to Claim 1 [or 2, characterised in that] wherein the connection pad [(12)] is fixed and coupled with its respective connection element [(4b; 24a; 24b)] by welding by means of a laser beam [(16),] which passes through the stiffening substrate [(8)] and the active circuit [(6)], [this] said substrate [(8)] and circuit [(6)] being transparent to the wavelength used for the welding, [this wavelength being for example 1.06 μm] whilst the pad [(12)] and/or the connection element [(4b; 24a, 24b)] is fusible under the effect of [this] said laser beam.

4. (Amended) A method according to [one of Claims 1 to 3, characterised in that] claim 1 wherein the support [(2)] for fixing the active circuit [(6)] is in roll form.

Attachment to Preliminary Amendment dated December 13, 2001

Marked-up Claims 1-14

5. (Amended) A method according to [one of Claims 1 to 4, characterised in that it includes] claim 1 further including, after the step of removing the stiffening substrate [(8)], a step of depositing, on the opposite face [(6b)], a protective film [(22), for example with a thickness of 5 to 15 μm, and] by lacquer printing[, provided that the communication interface has at least one ohmic contact area (4a) and a step of masking or removing the material of this film (22) on this area (4a) is possibly provided].

6. (Amended) A method according to [one of Claims 1 to 5, characterised by] claim 1 further including a step of cutting the assembly including the active circuit [(6)] and the stiffening substrate [(8)] into an assembly cut substantially to the dimensions of the circuit [(6)], before the step of presenting this assembly [(6, 8)].

7. (Amended) A method according to [one of Claims 1 to 6, characterised in that] claim 1 wherein each pad [(12)] is fixed with its respective connection element [(4b; 24a, 24b)] by [compression,] a compression force [being] that is applied through the stiffening substrate [(8)] of the assembly [(6, 8)].

8. (Amended) A method according to Claim [1 or] 6, [characterised in that] wherein the connection pad [(12)] is fixed and coupled with its respective connection element [(4b; 24a, 24b)] by welding by means of a laser beam [(16),] which passes through

Attachment to Preliminary Amendment dated December 13, 2001

Marked-up Claims 1-14

the stiffening substrate [(8)] and the active circuit [(6)], [this] said substrate [(8)] and circuit [(6)] being transparent to the wavelengths used for the welding, [this wavelength being for example 1.06 μm] whilst the pad [(12)] and/or the connection element [(4b; 24a, 24b)] is fusible under the effect of [this] said laser beam.

9. (Amended) Tooling [able to implement] for implementing the method according to Claim [6, characterised in that it includes] 8, comprising a laser with a wavelength [for example] of 1.06 μm, whose beam [(16)] is transmitted by a plurality of optical paths [(20)], each directed towards a respective pad [(12)] of the active circuit [(6)], in order to effect welds in parallel.

10. (Amended) Tooling according to Claim 9, [characterised in that] wherein each optical path is produced by at least one optical fibre [(20)].

11. (Amended) Tooling according to Claim 9 [or 10, characterised in that] wherein the optical paths [(20)] are integrated in a tool for positioning and/or holding the assembly [(6, 8)] vis-à-vis the final support [(2)].

12. (Amended) A device with an integrated-circuit chip [such as a smart card (6) or electronic label; this device having a support (2) associated with] comprising at least

Attachment to Preliminary Amendment dated December 13, 2001

Marked-up Claims 1-14

one active circuit [such as a chip (6)] with a front face [(6a)] provided with at least one connection pad [(12)] and an opposite face [(6b); this], said active circuit being a thin active circuit [(6)] which has mechanical flexibility, [such as a chip (6) or flat-screen display, and being] and which is mounted on [a final] said support [(2)]; [characterised in that it has:]

[-] an interface in the overall plane of one face [(2a)] of the [final] support [(2) an interface (4)] for communication with at least one element [(4b)] for connection with the active circuit [(6), on the final support (2)] and;

[- its] said connection pad [(12)] being fixed and electrically coupled against a corresponding connection element [(4b; 24a, 24b), for example by laser welding] on said interface.

13. (Amended) A device according to Claim 12, [characterised in that it has] further including a protective film [(22) with a thickness for example of 5 to 15 μm, such as a printed lacquer, with a limited extent or even] over the [entire] surface of the support [(2)].

14. (Amended) A device according to Claim 12 [or 13, characterised in that] wherein the thickness of the connection elements and of the active circuit [(6)] with its pads is less than 50 microns.

GEM657

A DEVICE AND METHOD FOR MANUFACTURING DEVICES COMPRISING AT LEAST ONE CHIP MOUNTED ON A SUPPORT

The present invention relates to a method for manufacturing devices composed of at least one microcircuit mounted on a support, for example for producing a smart card.

In certain fields, including that of smart cards, it is necessary to effect the mounting of a microcircuit or chip on a relatively thin and flexible support. In the case of smart cards, it is necessary on the one hand for the presence of the chip not to cause an excess thickness beyond a threshold established by international standards (currently fixed at 50 μm) and on the other hand for the mounting of the chip to be sufficiently secure to allow durable use even when the card is subjected to relatively high bending and twisting stresses.

In a conventional manner, the creation of an excessive thickness is avoided by housing the chip in a cavity provided for this purpose in the thickness of the support.

Figure 1 shows schematically a known example of mounting a chip 6 on a support 2 intended to constitute a smart card. The chip 6 is housed almost entirely in a cavity 3 so that its thickness is included within that of the support 2. The chip 6 has a set of connecting pads 5 on the edges of its surface turned towards the outside of the cavity 3. These pads 5 are connected to respective contacts 7 on the support by wires 9. The contacts 7 can be situated at the bottom of the cavity, or at an intermediate level in a recessed area 11 around the cavity, as in the example illustrated. These contacts 7 are in their turn electrically connected to contact areas 13 intended to allow an ohmic connection with a card reader. These contact areas 13 are housed entirely in the recess 11 so that their thickness is also contained within that of the support 2.

To protect the whole, a coating of protective material 15 is formed, covering the entire area occupied by the cavity 3, the wires 9 and a portion of the internal edges of the contact areas 11.

This conventional technique suffers from several drawbacks. Firstly, the operation consisting of electrically connecting the connecting pads 5 of the chip 6 to the contacts 7 requires the use of very fine and delicate wires 9, thus forming fragile points.

Moreover, the operations of soldering these wires 9 requires a significant amount of tooling and a not insignificant amount of time.

Moreover, the formation of the cavity 3 requires a machining step which is both expensive and weakening for the card.

In the light of these problems, the applicant proposes according to the present invention a method for mounting at least one active circuit, such as a chip, on a support making it possible to dispense with the need to form a cavity in the support without for all that creating a prohibitive excess thickness.

To this end, the present invention proposes a method for connecting to a support a chip produced in thin form, glued to a substrate. This type of chip has exceptional thinness, thus conferring a certain degree of mechanical flexibility. The chip is glued to a substrate at the manufacturing stage, the substrate serving amongst other things for the stiffening during the various steps of manufacturing the chip. There are currently on the market chips resulting from this technology, known by the term SOI ("silicon on insulator"), whose overall thickness (the substrate of the active surface plus connecting bumps) is around ten microns. In this regard, reference is made here to the patent document published under the number WO-A-98/02921, which discloses the technology for producing such chips.

However, SOI technology is particularly tricky when it is a case of connecting the chip to a support.

The techniques used at the present time comprise steps of manipulating the thin chip out of its stiffening substrate in order to position it and connect it to connection points on the support. The problem is then posed on the one hand of removing the chip from its substrate and handling the bare chip in order to fix it to its final support.

To resolve this problem, the present invention proposes a method for manufacturing a device having a support associated with at least one microcircuit in the form of a chip, the method being characterised in that it comprises, for the chip or chips, the steps consisting in:

- initially providing for the said chip an assembly composed of a thin chip held by a first face fixed to a substrate and having on a second opposite face at least one connection pad;
- forming, on one face of the support, a communication interface having at least one element for connection with the said chip;
- presenting the said assembly comprising the chip and the substrate against the communication interface, with each pad on the chip positioned against a corresponding connection element of the communication interface;
- connecting each pad with its respective connection element; and
- removing the said substrate from the said first face of the chip.

Thus the present invention makes it possible to manipulate the chips resulting from SOI technology whilst keeping the initial substrate. This substrate is notably maintained when the chip is connected to its connection elements for the support. In this way, the risks of damaging the chip during mounting are reduced to a minimum.

Application of the method according to the invention is particularly advantageous when it is wished to preserve the advantage of the thinness permitted by these thin substrates by associating them with thin supports. Thus the method according to the invention allows the assembly of one or more thin chips directly on the surface of the support and thus to obtain useable thin circuits without having to form a cavity in the support.

In a preferred embodiment, provision is also made for producing the communication interface on a portion of the surface situated in the overall plane of the said face of the support, that is to say the communication interface is formed so as to protrude from the surface of the support, and therefore without forming an indentation of the type illustrated in Figure 1.

A device is then obtained, such as a smart card, where all the elements attached to the support (communication interface and chip) are on the surface.

This is because the present invention makes it possible to use chips with a very high degree of thinness, which allows an acceptable excess thickness

for the metallisation forming the communication interface. In the case of a smart card, this communication interface can include contact areas to make it possible to connect the card to a reader of the "contact" type. It can also be electrically coupled to an antenna integrated into the card in order to form a "contactless" card, the exchange of signals with the chip and possibly its electrical power supply taking place by radio via the antenna.

Advantageously, each pad is connected with its respective connection element by welding with a laser beam.

It is notably possible, by virtue of the invention, to arrange the laser beam so that it passes through the substrate of the substrate and chip assembly. In other words, the welding points (for example bumps) on the chip are irradiated through the substrate. It should be noted in this regard that the substrates used notably in SOI technology are generally transparent to the wavelengths used for laser welding, being generally based on glass. The chip itself is transparent at the thickness envisaged.

In a preferred embodiment of the invention, the laser beam is transmitted by a plurality of optical paths, each directed towards a respective pad on the chip. In this way, the welding of several welding points on the chip can take place in parallel, affording a saving in manufacturing time.

Preferably, each optical path is produced by means of an optical fibre. The optical paths may, for

example, be integrated into the tool which positions and/or holds the chip on its location at the communication interface of the support.

According to one embodiment, each pad is produced from a metal alloy which melts under the laser beam and/or each portion of a connection element intended to be connected to a respective pad is produced from a material which melts under the laser beam.

However, the present invention makes it possible to use other techniques for connecting the chip to its respective connection element, according to the respective material of the pads and connection elements, for example:

- by heat welding, or
- by ultrasonic welding.

When the chip is fixed to its support, a step of depositing a protective layer on the chip after the removal of the substrate can also be carried out.

The invention also relates to a device with an integrated-circuit chip, such as a smart card, label, etc, having a support carrying a communication interface including connection elements connected to the connection pads of the chip. The device is characterised by the fact that the chip is disposed with its front face towards the support, its pads being connected directly to the connection elements of the interface; the chip is disposed above the surface of the support, and the thickness of the connection elements and of the chip with its pads is less than 50 microns.

Other advantages and characteristics of the invention will emerge more clearly from a reading of preferred embodiments, given purely by way of illustrative and non-limitative example, with reference to the accompanying drawings, in which:

- Figure 1, already described, is a diagram in section showing the mounting of a chip in a cavity in a support according to the prior art;

- Figure 2a is a partial plan view of a smart card support including a communication interface;

- Figure 2b is a view in section along the axis II-II' in Figure 2a;

- Figure 3a is a view in section of an assembly including a chip bonded to its substrate according to the SOI "flip chip" technology;

- Figure 3b is a plan view of a wafer including a group of assemblies of Figure 3 before cutting;

- Figure 4 is a view in section of the assembly depicted in Figure 3a positioned on its support;

- Figure 5 depicts a step of welding the assembly depicted in Figure 3a on its support;

- Figure 6 depicts a step of welding the assembly depicted in Figure 3a on its support according to a variant of Figure 5;

- Figure 7 is a view in partial section of a device composed of a chip mounted on its support at the end of the method according to one embodiment of the invention;

- Figure 8 is a partial plan view of a support with its communication interface intended for producing a contactless smart card; and

- Figure 9 is a view in section along the axis IIX-IIX' in Figure 8 showing the step of fixing an assembly including a chip bonded to its substrate according to the SOI "flip chip" technology.

Figure 2a depicts a support 2 which, in the example considered, consists of a plastic card intended to constitute a smart card according to established dimensional standards, for example ISO 7810.

To this end, there is created, at the support area 2 intended to receive a microcircuit (hereinafter referred to as a "chip"), a set of pads forming or connected to a communication interface 4. Such a communication interface 4 may, according to circumstances, serve to:

- connect the inputs and outputs of the chip with the outside, notably the card readers; and/or

- provide the necessary interconnections between the chip and elements produced at the support. These elements may be an antenna integrated into the support 2 so as to form a so-called "contactless card", known per se, or other circuit elements integrated in the card (for example one or more other chips), or an electric power supply source.

In the example illustrated, the communication interface 4 is formed on the one hand by interconnection pads 4a for connecting external equipment with the chip by ohmic contact and on the

other hand tracks 4b which connect the interconnection pads to the chip, as will be described below.

The communication interface 4 is formed on a portion of a surface of one of the faces 2a of the support 2 situated on the same plane as the remainder of this face 2a, as shown in Figure 2b. In other words, the portion of a surface containing the communication interface 4 is not recessed below the plane of the face 2a, as would be the case with a cavity or recess. Thus the communication interface 4 forms an excess thickness vis-à-vis the surface 2a of the support 2.

The communication interface 4 is produced according to techniques which allow the deposition of electrically conductive material intended to form this interface with a slight thickness e1 (Figure 2b). By way of example, the thickness e1 of the communication interface 4 is around 5 to 15 microns.

Several techniques known per se can be envisaged for producing this communication interface 4. In the example, the communication interface 4 is produced by printing, by means of a conductive ink containing particles of silver, conductive plates having the preformed configuration of the pads 4a and tracks 4b. It can also be envisaged producing the communication interface 4 by metallisation according to techniques of screen printing, vacuum deposition, etc. The conductive material used is typically based on copper, nickel or aluminium. This material may be incorporated in a binder adapted to the technique used.

The chip is produced according to a technology for obtaining a very thin substrate so that the chip can be deposited on the communication interface 4.

In the present embodiment, the microcircuit is produced according to SOI technology, that is to say silicon on insulator, making it possible to obtain particularly thin chips. The aspects specific to this technology are known, notably through the patent document WO-A-98/02921.

An example of an assembly including a chip and its substrate according to this SOI technology are depicted in Figures 3a and 3b.

Figure 3a is a view in longitudinal section which depicts a chip 6 mounted on an insulating substrate 8, in this case made from glass. The chip 6 is held fixed on the glass substrate 8 by adhesive pads 10. Thus the chip 6, its insulating substrate 8 and the adhesive pads 10 constitute an assembly, cut from a slice (cf Figure 3b).

As shown more clearly in Figure 3b, which depicts a plan view of a set of chips 6 on the substrate 8, the adhesive pads 10 hold the chip only by the corners thereof. Apart from the edges of the glass substrate 8, each adhesive pad 10 has a rectangular shape whose sides are turned by 45° with respect to the sides of the chip 6, and hold on the substrate 8 four grouped-together corners of four respective chips 6. The chips 6 are thereby held on the glass substrate 8 only by their corners.

The face 6a of the chip 6 opposite to that 6b facing the glass substrate 8 has a series of conductive protrusions 12 protruding slightly from this face 6a. The conductive protrusions 12, generally known by the English term "bumps", constitute the points of interconnection between the circuits of the chip 6 and the outside. These bumps 12 have a generally ogival shape allowing penetration into a material in the molten phase, for example by welding.

In the example, a single chip 6 is intended to be received on the aforementioned communication interface 4. The arrangement of the bumps 12 corresponds to that of the conductive tracks 4b or a portion of the interconnection pads 4a.

Each chip 6 is then cut from the set of chips with the portion of glass substrate 8 and the adhesive pad 10 situated directly under the chip 6. In this way a cut-out assembly is obtained, including the chip 6, portions of adhesive 10 at the corners of the chip and a portion of glass substrate 8 substantially to the dimensions of the chip (Figure 3a).

As shown in Figure 4, this assembly is positioned on the communication interface 4 produced on the support 2, with the bumps 12 aligned with the portions of respective tracks 4b in order to effect the necessary interconnections.

It should be noted that, when the chip 6 is positioned on its definitive support (which is here the plastic support 2 which constitutes the body of the smart card), the face 6a defined previously is no

longer turned outwards, but facing this support 2. In other words, it undergoes a turning through 180° between its configuration just after its manufacture and its definitive positioning. This technique of turning the chip 6 with respect to its original substrate is known by the English term "flip chip".

Once the chip 6 is correctly positioned, the bumps 12 are fixed with respect to the respective connection points (which are here portions of tracks 4b).

In the preferred embodiment of the invention, this fixing is effected by applying energy through the original substrate 8 of the chip 6. This energy is supplied by a laser 14 which transmits a beam 16 directed against the face 8a of the substrate turned outwards. The beam 16 passes right through the thickness of the substrate 8 and the thickness of the chip 6 on an axis containing a bump 12, so as to transfer heat energy thereto.

This heat energy absorbed at the bump 12 allows the bump 12 to melt, the latter being produced from an easily fusible metal alloy such as tin or lead.

When a bump is thus welded, the laser 14 is moved in order to be placed in the axis of the following bump, and to carry out the welding thereof.

Each bump 12 is thus welded by the laser beam 16 on its corresponding connection point 4b of the communication interface 4.

In a variant, it is possible to produce welding pads at the points 4b of the communication interface 4 intended to receive the respective bumps 12. These

pads are then produced from a material able to melt under the thermal energy transferred by the laser beam 16, through the respective bumps 12 in order to weld the latter.

In the example, the glass making up the substrate 8 is transparent to the wavelengths of the laser beams normally used for microwelding. It is notably possible to use for the welding a laser of the YAGNd type emitting a wavelength of 1.06 microns.

The laser 14 can be mounted on a positioning robot 18 enabling the laser beam 16 to be aligned successively with each bump 12 on the chip 6 held in position on its support 2.

Figure 6 depicts a variant according to which several weldings of bumps 12 are carried out simultaneously using a laser 14 by means of a set of optical paths 20 each transporting a laser beam 16 to respective positions in alignment with a bump 12. The optical paths 20 can consist of optical fibres. In this case, at least one optical fibre is positioned perpendicularly opposite the face 8a of the glass substrate 8 (the one turned towards the outside in the assembly position) vertically in line with each bump 12. The energy transmitted by the fibres 20 effects the welding as described previously. The power of the laser 14 will be adapted to the number of optical paths used. If necessary, it is possible to use several different laser sources to supply the optical paths.

The ends 20a of the fibres can be integrated into the tool for positioning and holding the chip vis-à-vis the support 2. The ends 20a of the fibres are disposed according to the configuration of the bumps 12 to be welded on the communication interface 4. It is possible to provide for this purpose a frame enabling several chips 6 to be assembled and welded on the same support 2 or on different supports.

This variant has the advantage of making it possible to produce all the welds of the bumps 12 simultaneously.

Once the welds have been carried out, the glass substrate 8 is removed from the chip 6. This operation can be effected by peeling off the substrate 8, the force for holding the adhesive pads 8 being substantially lower than that of the welds of the bumps 12 on the connection interface.

The result of this operation is that the chip 6 is electrically and mechanically connected to the surface of the support 2. To protect the chip 6, a film 22 is applied to the exposed surface 6b of the chip, as shown in Figure 6. This film 22 can be produced by a simple impression of lacquer able to protect the circuit from climatic and mechanical stresses. The extent of the film 22 can be limited so as not to cover the interconnection pads 4a so that these can provide an ohmic contact. However, it can be envisaged forming the film 22 on a larger part of the support 2, or even over its entire surface, provided that a step of

masking the ohmic contact areas 4a or of removing material of the film 22 at these areas is provided.

The first embodiment is based on a so-called "contact" smart card, in the sense that it is designed to communicate with the outside through the ohmic contact areas 4a.

However, the method according to the present invention also lends itself to producing so-called "contactless" cards. These cards, used amongst other things for remote paying or access control systems, make it possible to establish communication at a distance by radio link between the outside and the chip or chips 6 of the card.

An example of such a card is depicted in Figure 8. The card 2 is provided with an antenna 24 having its ends 24a and 24b connected to contacts - here in the form of bumps 12 - provided for this purpose on the chip 6, as shown in Figure 9.

In the example, two connections are produced at the two ends 24a and 24b of the antenna 24 with two respective bumps 12 on the face 6a of the chip 6 produced in SOI technology turned towards the support, as with the first embodiment.

In the example, the welding is carried out by a beam 16 coming directly from a laser 14 mounted on a positioning robot 18, as described previously with reference to Figure 5. It is of course also possible to provide tooling with several optical paths 20 making it possible to effect welds in parallel, as described with reference to Figure 6.

The steps following on from the welding of the bumps 12 with their respective contact points 24a, 24b are the same as those described previously, notably with regard to the removal of the glass substrate 8 and the production of the protective film 22.

The invention is remarkable in that it makes it possible to produce chip assemblies mounted on very thin supports without having recourse to a cavity or other recess at the point on the support intended to receive the chip.

In the examples described, based on smart cards, it is notably possible to comply with the industrial standards ISO 7810 with regard to the maximum excess thickness allowed on the general plane of the card (currently fixed at 50 microns). This is because the total excess thickness due to the surface mounting of the assembly forming the communication interface 4, chip 6 and protective film 22 is broken down as follows:

- thickness of the metallisation forming the communication interface ≤ 30 µm;
- thickness of the chip 6 resulting from SOI technology as described in the patent document WO-A-989/02921 = 10 µm (5 µm for the active circuit + 5 µm for the bumps 12);
- thickness of the protective film = 5 to 15 µm.

The present invention lends itself to many variants.

Thus it should be noted that the chip 6 can be connected to forms of support other than the support 2 described above. It is in fact just as possible to fix the chip 6 to a single-face printed circuit (for example in roll form), to a grid without dielectric or to any other support able to integrate a chip 6 mechanically and electrically.

Moreover, the scope of the invention extends well beyond the field of smart cards. It can be implemented in all fields which have recourse to active circuits mounted on supports, notably data processing cards, flat-screen displays, etc.

CLAIMS -

1. A method for manufacturing a device with an integrated circuit chip such as a smart card or an electronic label; this device having a support (2) associated with at least one active surface such as a chip (6) with a front face (6a) provided with at least one connection pad (12) and an opposite face (6b); this method comprising the steps consisting of: initially providing for the active circuit a thin active circuit (6) which has mechanical flexibility, such as a chip (6) or flat-screen display; keeping the thin active surface (6) fixed to a stiffening substrate (8) through its opposite face (6b) referred to as the first face; removing the active circuit (6) from its stiffening substrate (8); mounting the active circuit (6) on a final support (2); characterised by the steps consisting in:

- presenting the active circuit in an assembly composed of this thin active circuit (6) and the stiffening substrate (8);
- forming in the general plane of a face (2a) of the final support (2) a communication interface (4) having at least one element (4b) for connection with the active circuit (6), on the final support (2); then
- presenting this assembly, comprising the active circuit (6) with its stiffening substrate (8), against the communication interface (4), with the connection pad (12) against a corresponding connection element (4b; 24a, 24b);

- fixing and electrically coupling the connection pad (12) with its connection element (4b; 24a, 24b), for example by laser welding; then

- removing the stiffening substrate (8) from the opposite face (6b).

2. A method according to Claim 1, characterised in that the communication interface (4) is formed or produced in the form of an ohmic contact area (4a) and/or antenna area (24), protruding on a portion of a surface in the overall plane of the face (2a) of the final support (2).

3. A method according to Claim 1 or 2, characterised in that the pad (12) is fixed and coupled with its respective connection element (4b; 24a; 24b) by welding by means of a laser beam (16), which passes through the stiffening substrate (8) and the active circuit (6), this substrate (8) and circuit (6) being transparent to the wavelength used for the welding, this wavelength being for example 1.06 µm whilst the pad (12) and/or the connection element (4b; 24a, 24b) is fusible under the effect of this laser.

4. A method according to one of Claims 1 to 3, characterised in that the support (2) for fixing the active circuit (6) is in roll form.

5. A method according to one of Claims 1 to 4, characterised in that it includes, after the step of removing the stiffening substrate (8), a step of depositing, on the opposite face (6b), a protective film (22), for example with a thickness of 5 to 15 µm, and by lacquer printing, provided that the

communication interface has at least one ohmic contact area (4a) and a step of masking or removing the material of this film (22) on this area (4a) is possibly provided.

6. A method according to one of Claims 1 to 5, characterised by a step of cutting the assembly including the active circuit (6) and the stiffening substrate (8) into an assembly cut substantially to the dimensions of the circuit (6), before the step of presenting this assembly (6, 8).

7. A method according to one of Claims 1 to 6, characterised in that each pad (12) is fixed with its respective connection element (4b; 24a, 24b) by compression, a compression force being applied through the stiffening substrate (8) of the assembly (6, 8).

8. A method according to Claim 1 or 6, characterised in that the pad (12) is fixed and coupled with its respective connection element (4b; 24a, 24b) by welding by means of a laser beam (16), which passes through the stiffening substrate (8) and the active circuit (6), this substrate (8) and circuit (6) being transparent to the wavelengths used for the welding, this wavelength being for example 1.06 µm whilst the pad (12) and/or the connection element (4b; 24a, 24b) is fusible under the effect of this laser.

9. Tooling able to implement the method according to Claim 6, characterised in that it includes a laser with a wavelength for example of 1.06 µm, whose beam (16) is transmitted by a plurality of optical paths (20), each directed towards a respective pad (12)

of the active circuit (6), in order to effect welds in parallel.

10. Tooling according to Claim 9, characterised in that each optical path is produced by at least one optical fibre (20).

11. Tooling according to Claim 9 or 10, characterised in that the optical paths (20) are integrated in a tool for positioning and/or holding the assembly (6, 8) vis-à-vis the final support (2).

12. A device with an integrated-circuit chip such as a smart card (6) or electronic label; this device having a support (2) associated with at least one active circuit such as a chip (6) with a front face (6a) provided with at least one connection pad (12) and an opposite face (6b); this active circuit being a thin active circuit (6) which has mechanical flexibility, such as a chip (6) or flat-screen display, and being mounted on a final support (2); characterised in that it has:

- in the overall plane of one face (2a) of the final support (2) an interface (4) for communication with at least one element (4b) for connection with the active circuit (6), on the final support (2);

- its connection pad (12) fixed and electrically coupled against a corresponding connection element (4b; 24a, 24b), for example by laser welding.

13. A device according to Claim 12, characterised in that it has a protective film (22) with a thickness for example of 5 to 15 µm, such as a printed lacquer,

with a limited extent or even over the entire surface of the support (2).

14. A device according to Claim 12 or 13, characterised in that the thickness of the connection elements and of the active circuit (6) with its pads is less than 50 microns.

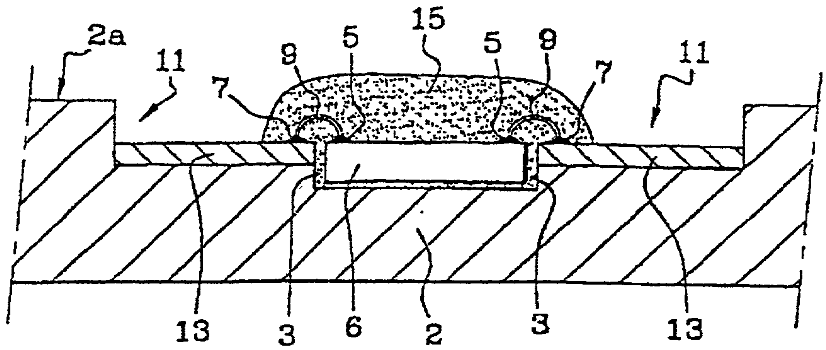
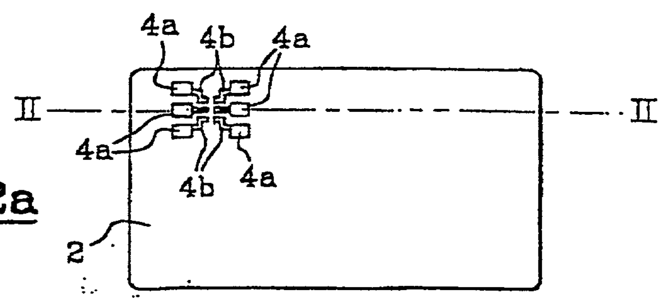


FIG.1

PRIOR ART

FIG.2a



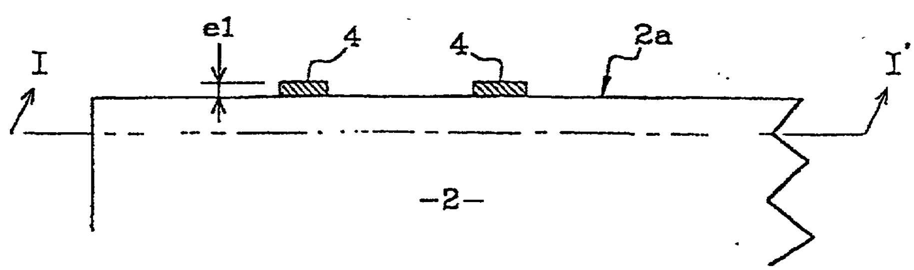


FIG.2b

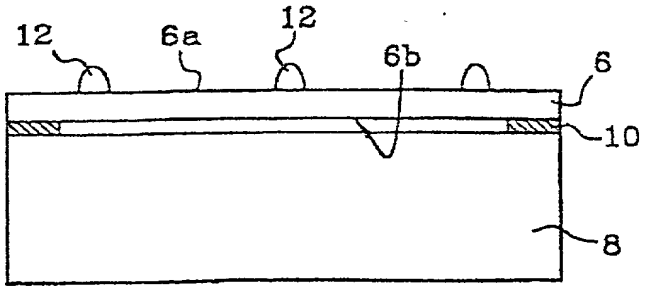


FIG.3a

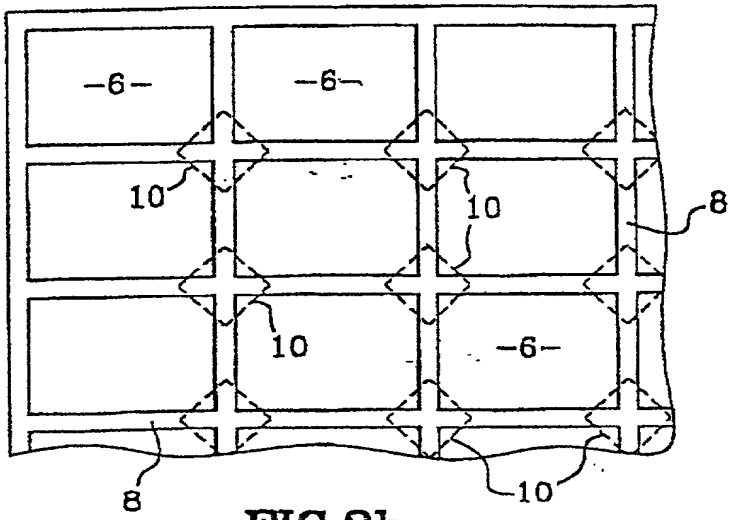


FIG.3b

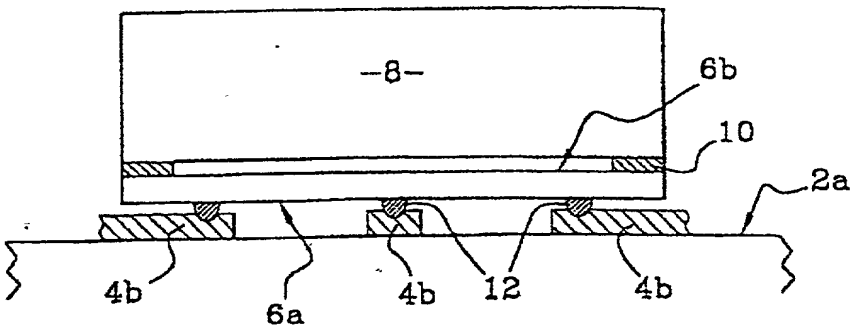


FIG.4

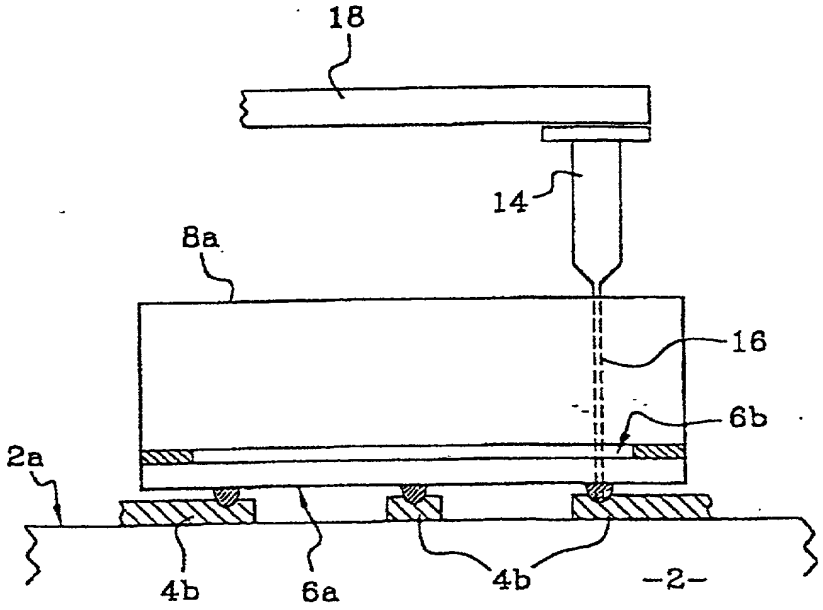


FIG.5

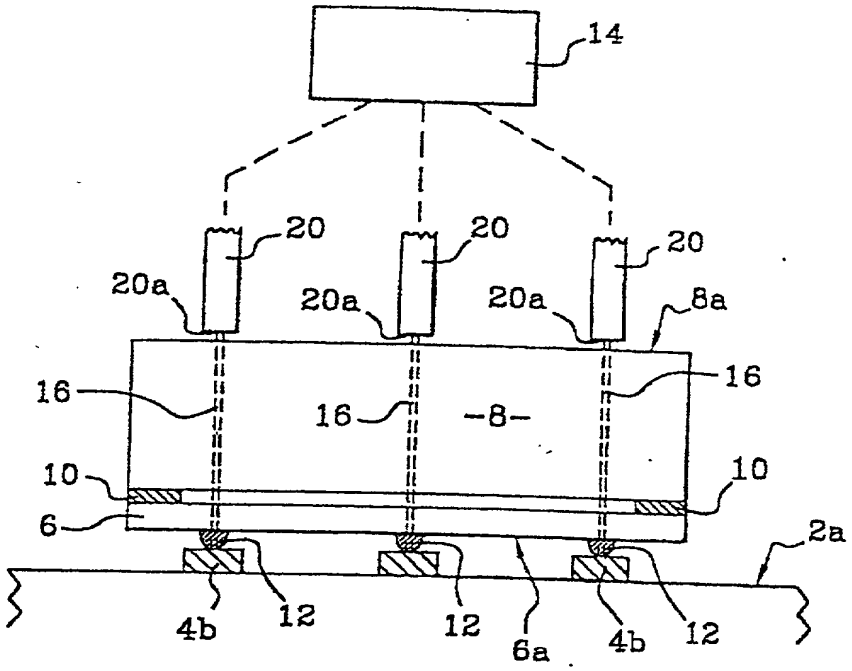

14
20
20
20
20a
20a
20a
8a
16
16
16
-8-
10
10
6
2a
4b
12
12
6a
4b
12

FIG.6

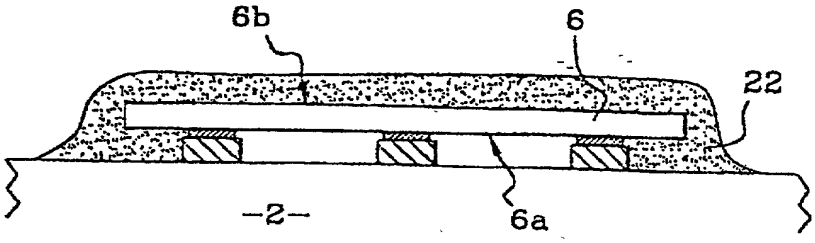

6b
6
22
-2-
6a

FIG.7

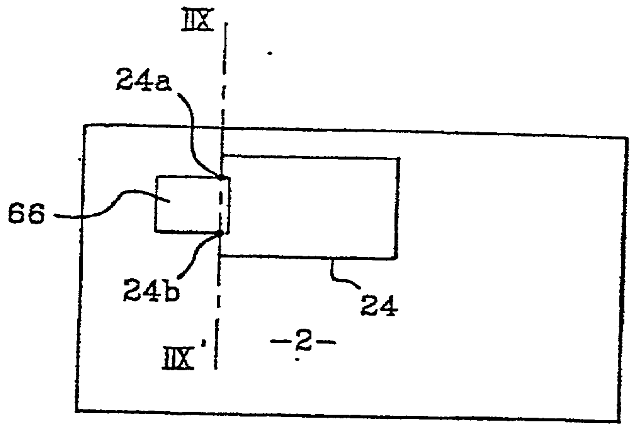


FIG.8

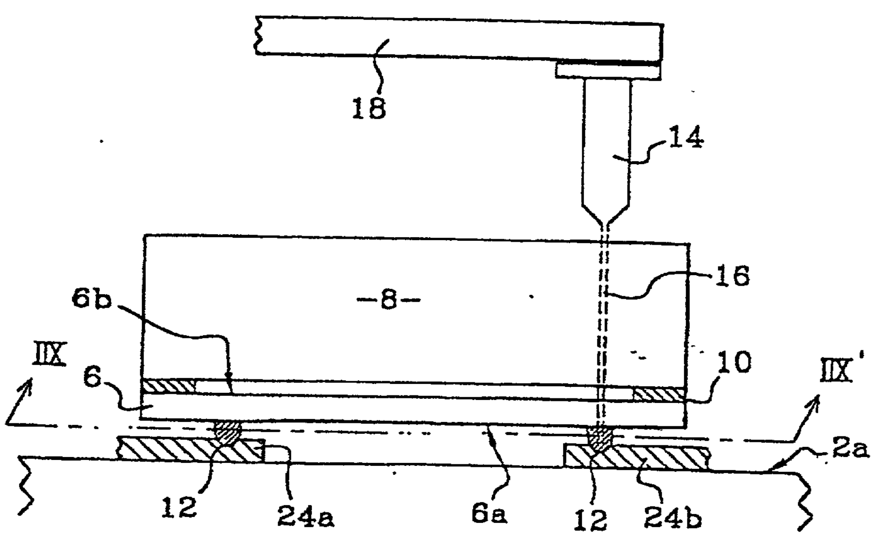


FIG.9

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to Provisional and International (PCT) Applications)	Attorney's Docket No. GEM657

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name;
I BELIEVE I AM THE ORIGINAL, FIRST AND SOLE INVENTOR (IF ONLY ONE NAME IS LISTED BELOW) OR AN ORIGINAL, FIRST AND JOINT INVENTOR (IF PLURAL NAMES ARE LISTED BELOW) OF THE SUBJECT MATTER WHICH IS CLAIMED AND FOR WHICH A PATENT IS SOUGHT ON THE INVENTION ENTITLED:

Device and method for making devices comprising at least a chip mounted on a support

The specification of which **(check only one item below)**:

☐ is attached hereto.

☐ was filed as United States Patent Application Number ___
on__
and was amended on _____ (if applicable).

☒ was filed as International (PCT) Application Number PCT/FR00/01494
on May 30 th 2000
and was amended on July 16th, 2001FRANCE (if applicable).

I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS, AS AMENDED BY ANY AMENDMENT REFERRED TO ABOVE.

I ACKNOWLEDGE THE DUTY TO DISCLOSE TO THE U.S. PATENT AND TRADEMARK OFFICE ALL INFORMATION KNOWN TO ME TO BE MATERIAL TO PATENTABILITY AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, Sec. 1.56 (as amended effective March 16, 1992);

I do not know and do not believe the said invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to said application; that said invention was not in public use or on sale in the United States of America more than one year prior to said application; that said invention has not been patented or made the subject of an inventor's certificate issued before the date of said application in any country foreign to the United States of America on any application filed by me or my legal representatives or assigns more than six months prior to said application;

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119 (a)-(e) of any foreign application(s) for patent or inventor's certificate or of any International (PCT) Application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT International (PCT) Application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. §119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. §119
France	FR99/07549	15/06/1999	☒Yes ☐No
			☐Yes ☐No
			☐Yes ☐No
			☐Yes ☐No
			☐Yes ☐No

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

(APPLICATION NUMBER) (FILING DATE)

(APPLICATION NUMBER) (FILING DATE)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONT'D) (Includes Reference to Provisional and International (PCT) Applications)	Attorney's Docket No. GEM657

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States applications(s) or International (PCT) Application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to the patentability as defined in Title 37, Code of Federal Regulations § 1.56, which became available between the filing date of the prior application(s) and the national or international filing date of this application:

PRIOR U.S. APPLICATIONS OR INTERNATIONAL (PCT) APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C § 120:

U.S. APPLICATIONS			STATUS *(check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE		PATENTED	PENDING	ABANDONED
			☐	☐	☐
PCT APPLICATIONS DESIGNATING THE U S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. APPLICATION NUMBERS ASSIGNED (if any)			

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the U.S. Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

William L. Mathis	17,337
Robert S. Swecker	19,885
Platon N. Mandros	22,124
Benton S. Duffett, Jr	22,030
Norman H. Stepno	22,716
Ronald L. Grudziecki	24,970
Frederick G Michaud, Jr	26,003
Alan E. Kopecki	25,813
Regis E. Slutter	26,999
Samuel C. Miller, III	27,360
Robert G. Mukai	28,531
George A. Hovanec, Jr.	28,223
James A. LaBarre	28,632
E. Joseph Gess	28,510
R. Danny Huntington	27,903
Eric H Weisblatt	30,505
James W Peterson	26,057
Teresa Stanek Rea	30,427
Robert E Krebs	25,885
William C. Rowland	30,888
T. Gene Dillahunty	25,423
Patrick C Keane	32,858
B Jefferson Boggs, Jr	32,344
William H. Benz	25,952
Peter K. Skiff	31,917
Richard J. McGrath	29,195
Matthew L. Schneider	32,814
Michael G. Savage	32,596
Gerald F. Swiss	30,113
Charles F. Wieland III	33,096
Bruce T. Wieder	33,815
Todd R Walters	34,040
Ronni S Jillions	31,979
Harold R. Brown III	36,341
Allen R Baum	36,086
Steven M. duBois	35,023
Brian P. O'Shaughnessy	32,747
Kenneth B. Leffler	36,075
Fred W Hathaway	32,236

21839

and: ________________________________.

Address all correspondence to:

BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404

21839

Address all telephone calls to: ________________________ at (703) 836-6620.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONT'D) (Includes Reference to Provisional and International (PCT) Applications)	Attorney's Docket No. GEM657

FULL NAME OF SOLE OR FIRST INVENTOR Philippe PATRICE	SIGNATURE	DATE 12/07/01
RESIDENCE (CITY & STATE/COUNTRY) 54, bld des Cigales – 13011 MARSEILLE / FRANCE FPX		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS) 54, bld des Cigales – 13011 MARSEILLE / FRANCE		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY FIDALGO Jean-Christophe	SIGNATURE	DATE 12/03/01
RESIDENCE (CITY & STATE/COUNTRY) 4, rue de la Cortine - - 13420 GEMENOS / FRANCE FPX		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS 4, rue de la Cortine - - 13420 GEMENOS / FRANCE		
FULL NAME OF THIRD JOINT INVENTOR, IF ANY CALVAS Bernard	SIGNATURE	DATE 3 dec 01
RESIDENCE (CITY & STATE/COUNTRY) 30, ~~groupe de provence Avenue de Verdun 13400 AUBAGNE - FRANCE~~ FPX		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS ~~30, groupe de provence Avenue de Verdun 13400 AUBAGNE - FRANCE~~		
FULL NAME OF FOURTH JOINT INVENTOR, IF ANY	SIGNATURE	DATE
RESIDENCE (CITY & STATE/COUNTRY)		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS		
FULL NAME OF FIFTH JOINT INVENTOR, IF ANY	SIGNATURE	DATE
RESIDENCE (CITY & STATE/COUNTRY)		CITIZENSHIP
POST OFFICE ADDRESS (HOME ADDRESS		

Villa 38
22, rue Thy de Monnier
13011 MARSEILLE

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONT'D) (Includes Reference to Provisional and International (PCT) Applications)	Attorney's Docket No. GEM657

FULL NAME OF SOLE OR FIRST INVENTOR Philippe PATRICE	SIGNATURE	DATE
RESIDENCE (CITY & STATE/COUNTRY) 54, bld des Cigales – 13011 MARSEILLE / FRANCE		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS) 54, bld des Cigales – 13011 MARSEILLE / FRANCE		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY FIDALGO Jean-Christophe	SIGNATURE	DATE
RESIDENCE (CITY & STATE/COUNTRY) 4, rue de la Cortine - - 13420 GEMENOS / FRANCE		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS 4, rue de la Cortine - - 13420 GEMENOS / FRANCE		
FULL NAME OF THIRD JOINT INVENTOR, IF ANY CALVAS Bernard	SIGNATURE	DATE 3. dec. 01
RESIDENCE (CITY & STATE/COUNTRY) Villa 38 – 22, Rue Thyde Monnier 13011 MARSEILLE - FRANCE		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS Villa 38 – 22, Rue Thyde Monnier 13011 MARSEILLE - FRANCE		
FULL NAME OF FOURTH JOINT INVENTOR, IF ANY	SIGNATURE	DATE
RESIDENCE (CITY & STATE/COUNTRY)		CITIZENSHIP FRENCH
POST OFFICE ADDRESS (HOME ADDRESS		
FULL NAME OF FIFTH JOINT INVENTOR, IF ANY	SIGNATURE	DATE
RESIDENCE (CITY & STATE/COUNTRY)		CITIZENSHIP
POST OFFICE ADDRESS (HOME ADDRESS		